

exposing a patterned substrate surface at a pressure between about 5 mTorr and about 20 mTorr to a plasma generated at a power level between about 300 watts and about 450 watts from a gas mixture consisting of less than 75% by volume of argon and a mixture of about 95% by volume of helium and about 5% by volume of hydrogen.

37. (New) The method of claim 36, wherein the patterned substrate comprises a feature having an aspect ratio great than about 4 to 1.

38. (New) The method of claim 36, wherein the gas mixture comprises about 50% by volume of argon, about 48 % by volume of helium, and about 2% by volume of hydrogen.

39. (New) The method of claim 36, wherein the gas mixture comprises about 25% by volume of argon, about 71% by volume of helium, and about 4% by volume of hydrogen.

40. (New) The method of claim 36, further comprising increasing the helium content of the plasma while decreasing the argon content of the plasma.

REMARKS

This is intended as a full and complete response to the Final Office Action dated November 20, 2001. Claims 1, 3-8, and 10-30 are pending in the application. Applicants have added new claims 31-40 to more clearly define aspects of the invention. Please reconsider the claims for reasons discussed below.

Claims 1, 3, 5, 6, 7, 24-25, 27-30 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Konecni et al.* (EP 0849 779 A2). The Examiner states that although *Konecni et al.* does not specifically disclose the percent by volume of argon, it is well known in the art that etching parameters, such as etchant concentration, temperature, and flow rate, affect both the rate and quality of the plasma etching process. The

Examiner, therefore, asserts that it would have been obvious to adjust *Konecni's* etchant concentration by optimizing the same using routine experimentation for the purpose of obtaining the best etch rate.

Applicants respectfully traverse the rejection on grounds that the Examiner has not established a *prima facie* case of obviousness. Applicants disagree with the Examiner's assertion that "it is well known in the art that etching parameters, such as etchant concentration, temperature, and flow rate, affect both the rate and quality of the plasma etching process." No prior art has been cited to support this assertion. Insofar as this record shows, if such a fact is well known, it is only from the Applicant's own disclosure. Obviousness is determined at the time of the invention, not by what is later learned in the art or by what is gleaned from the Applicant's own disclosure.

As admitted by the Examiner, *Konecni et al.* does not specifically disclose a percent by volume, and certainly not less than 75% of argon. *Konecni et al.* teaches a method for coupling conductive material to a contact region of a semiconductor device by bombarding residual material coupled to the contact region with inert ions to increase the reactive surface area of a residual material. *Konecni et al.* also teaches using hydrogen ions to react with the bombarded residual material. (See, *Konecni et al.* at col. 6, lines 40-48). *Konecni et al.* further teaches that "simultaneously bombarding residual material with inert ions significantly increases the effectiveness of the chemical cleaning process associated with hydrogen ions." (See, *Konecni et al.* at col. 8, lines 25-28). Therefore, *Konecni et al.* does not teach, show, or suggest a method for processing a substrate in a processing chamber, comprising exposing a patterned substrate surface to a plasma generated from a gas mixture consisting of argon, helium and hydrogen, wherein the gas mixture comprises less than about 75% by volume of argon, as recited in base claims 1, 24, new claim 31, and new claim 36, as well as those dependent therefrom. Withdrawal of the rejection is respectfully requested.

Furthermore, the Examiner has provided no evidence as to which parameter or parameters, if any at all, are result-effective variables. A particular parameter must first be recognized as a result-effective variable, *i.e.* a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antoine*, 559 F.2d 618,

195USPQ 6 (CCPA 1977). See also *In re Bosch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Accordingly, withdrawal of the rejection is respectfully requested.

Alternatively, the claimed invention achieves unexpected and surprising results over the prior art. The claimed invention provides a method for processing a substrate in a processing chamber that enhances the etch rate of the substrate by exposing the substrate to a plasma generated from a gas mixture consisting of argon, helium and hydrogen wherein the helium content of the plasma is increased to increase the etch rate of the patterned substrate surface. (See, specification at page 5, lines 24-31 and Figure 4.) As shown in Figure 4 of the application, the etch rate increased as the volume of argon decreased from 75% by volume to 25% by volume. This correlation is contrary to expectations. One would have expected the etch rate to decrease as the volume of argon within the plasma decreased. The claimed invention is contrary to what would have been expected by one having ordinary skill in the art and thus, nonobvious in view of the prior art. Accordingly, Applicants respectfully request withdrawal of the rejection.

Claims 1, 3, 5, 6, 7, 24-25, 27-30 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Tran et al.* (U.S. Patent No. 5,534,445). The Examiner states that although *Tran et al.* does not specifically disclose the percent by volume of argon, it is well known that etching parameters, such as etchant concentration, temperature, and flow rate, affect both the rate and quality of the plasma etching process. The Examiner, therefore, asserts that it would have been obvious to adjust the etchant concentration of *Tran et al.* by optimizing the same using routine experimentation for the purpose of obtaining the best result.

Applicants' argument above with reference to *Konechi et al.* is equally applicable to *Tran et al.* Withdrawal of the rejection is respectfully requested.

Claims 4, 8, 10-23, and 26 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Konecni et al.* (EP 0849 779 A2) in view of *Kennard* (U.S. Patent No. 5,935,874). Claims 4, 8, 10-23, and 26 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Tran et al.* (U.S. Patent No. 5,534,445) in view of *Kennard* (U.S. Patent No. 5,935,874). The Examiner states that neither *Konecni et al.* nor *Tran et al.* specifically discloses the step of increasing the helium content/flow rate to increase

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etching of the patterned substrate surface. The Examiner states that *Kennard* discloses a method for plasma etching a trench comprising the step of adding/increasing a flow volume of helium to a gas mixture chemistry. The Examiner, therefore, asserts that it would have been obvious to modify *Konecni et al./Tran et al.* by increasing the helium content/flow rate to the gas mixture as per *Kennard* "especially because *Kennard* teaches that it is believed that the addition of a relatively high flow volume of helium improves the directionality of the etch by increasing the ion energy, thereby increasing the vertical etch rate into the trench." The Examiner further asserts that it is well known that etching parameters, such as etchant concentration, temperature, and flow rate, affect both the rate and quality of the plasma etching process; therefore, it would have been obvious to adjust the etchant concentration of *Konecni et al./Tran et al.* by optimizing the same using routine experimentation for the purpose of obtaining the best result.

Applicants respectfully traverse the rejection on grounds that the Examiner has not established a *prima facie* case of obviousness. To establish *prima facie* obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. See, *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Further, the teaching or suggestion to make the claimed invention and the reasonable expectation of success must both be found in the prior art, not in the applicants' disclosure. See M.P.E.P. § 2143, citing *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). Still further, the examiner must *particularly* identify any suggestion, teaching or motivation from within the references to combine the references. See, *In Re Dembiczak*, 50 USPQ2d 1614 (Fed. Cir. 1999). The mere recitation of a combination of references does not amount to particularly identifying a suggestion, teaching, or a motivation to combine the references. Furthermore, obviousness is tested by what combined teachings of prior art references would have suggested to those of ordinary skill in art, not by whether particular combination of elements from such references might have been "obvious to try." *In re Fine* (CA FC) 5 USPQ2d 1596 (1/26/1988).

Konecni et al. and *Tran et al.* have been distinguished above. None of the references, *Konecni et al.*, *Tran et al.* nor *Kennard*, teach that increasing the volume of helium increases the rate of etching. In fact, *Konecni et al.* and *Tran et al.* do not

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differentiate inert ions. *Kennard* teaches a method for etching a trench in a monocrystal silicon layer using a "relatively" high flow rate of helium added to an oxygen/fluorine-based etchant gas, not hydrogen/argon as recited in the pending claims. (See, *Kennard* at col. 3, lines 54-61). Specifically, *Kennard* teaches a high volume of helium, such as more than 65% of the total volume flow. (See, *Kennard* at col. 4, lines 13-15). However, *Kennard* does not teach, show, or suggest increasing the helium content to increase etching of the patterned substrate surface, as recited in claims 4, 8, 10-23, 26, and new claims 31-35. Therefore, a combination of the references does not teach, show, or suggest increasing the helium content to increase etching of the patterned substrate surface, as recited in claims 4, 8, 10-23, 26, and new claims 31-35. Withdrawal of the rejections is respectfully requested.

Additionally, Applicants note that a previous rejection of claims 4, 8, and 10-23 under 35 U.S.C. §103(a) as being unpatentable over *Konecni et al.* (EP 0849 779 A2) in view of *Jen* (U.S. Patent No. 5,773,367) was neither re-asserted nor withdrawn by the Examiner. Applicants, therefore, infer that the rejection was successfully traversed and thus, withdrawn by the Examiner. Applicants respectfully request an expressed withdrawal of this rejection.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed invention. Having addressed all issues set out in the office action, applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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